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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20544

In the Matter of	)	
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Amendment of the Commission's	)	GEN Docket No. 90-314
Rules to Establish New Personal	)	ET Docket No. 92-100
Communications Services	)	
	)	

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

COMMENTS OF HITACHI TELECOM (USA), INC.

Hitachi Telecom (USA), Inc. submits the following Comments in response to the Commission's Notice of Proposed Rulemaking and Tentative Decision released by the Commission on August 14, 1992, regarding the regulatory policies for new Personal Communications Services (PCS).

Hitachi Telecom, which is a subsidiary of Hitachi America, Ltd., is responsible for the research, engineering, manufacturing and service for Hitachi's telecommunications products sold in North America. Foremost of these products is the PBX system, which we have provided to the U.S. lodging industry and other market sectors since 1969. The potential for wireless PBXs to revolutionize telecommunications within the workplace is the motivation for our interest in the Commission's Rules to Establish New Personal Communications Services.

Our comments will focus on the proposed rules for unlicensed PCS in the 2 GHz allocation.[1] We believe the unlicensed systems will be the first commercial PCS products and as such are extremely important in the public's perception of all PCS devices. These devices will offer

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[1] Paragraphs 41-45, 121-124, and Appendix A of the Notice

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many new exciting services and products for consumers. We commend the Commission for recognizing the need and benefit of allocating spectrum for this purpose.

We agree with the stated goal that the regulatory structure should foster the development of high quality, low cost systems. However, because of the non-licensed nature of unlicensed PCS, there are unique problems that must be overcome to provide a "diversity of services" as desired by the Commission. An additional level of complexity in the spectrum sharing problem is caused by the need for different products to share the band with a minimum of interference while also protecting the existing incumbents. For this reason, we believe the spectrum allocated to unlicensed PCS will have to be cleared in order for this band to reach its full potential.

Our comments are organized as follows:

- Need for additional spectrum for unlicensed PCS
- Technical Standards
  - Channelization
  - Frequency Stability
  - Spectrum Monitoring
- Relocation and Industry Standards

I. Need for additional spectrum for unlicensed PCS

We believe that unlicensed PCS offers the greatest near-term potential for new products. Considering the many potential unlicensed PCS products mentioned in this Notice, we recommend that the Commission consider making future allocations for additional spectrum in the 2 GHz band for unlicensed PCS. There are many regulatory problems that still must be resolved for licensed PCS, such as how will licenses be awarded, who will be allowed to receive licenses, etc. Unlicensed PCS can avoid these potentially lengthy delays so products can be on the market sooner.

The 20 MHz currently proposed will be enough to encourage the design and development of new devices and to begin the introduction of products for this band, but the Commission must make provisions for more spectrum to avoid regulatory delays when the demand exceeds the

current allotment. Provisions made in this Rulemaking will show the Commission's support and further stimulate the industry to introduce new products.

We also recommend that the Commission consider separate allocations for voice and data applications, respectively. Wireless local area networks (LANs) may need more than the 10 MHz wideband channel currently proposed to achieve the data rates needed to be compatible with existing wired data networks. In a wired office today, LAN terminals (PCs) are located very close to telephones, typically on the same desktop. The potential for interference is obvious if both the LAN and the telephone become wireless and share the same spectrum.

II. Channelization of the unlicensed 2 GHz band

We agree with the need to provide channelization for the unlicensed band in order to allow more structure in the Proposed Rules than is currently possible in the ISM allocations. However, in determining channelization several factors must be balanced in addition to providing channel bandwidth suitable for various applications. The channelization must be sufficiently flexible to permit different applications and allow different access technologies. Also, the rules should favor low cost spectrally efficient implementations wherever possible.

While agreeing with the basic goals of the channelization plan, we do not believe it is sufficiently flexible as it is currently proposed. We agree that various channel bandwidths should be set aside for different applications and technologies. A 10 MHz channel for wideband applications appears reasonable. Our primary concern is with the two narrower band channels, specified at 100 kHz and 1.25 MHz channel bandwidth. Four channels for applications requiring 1.25 MHz does not appear adequate to support a reasonable amount of traffic and at the same avoid interference with incumbents and other PCS devices. There are other applications that require more bandwidth than 100 kHz but less than 1.25 MHz. We recommend an intermediate channel bandwidth that could supplement or replace the 100 kHz channels.

Obviously, no one plan will satisfy all parties. But we would like to propose an alternative channelization plan that, in our opinion, better meets the varied needs of unlicensed PCS and, in

particular, addresses the demanding requirements of in-building wireless office systems (WOS). These types of systems include wireless PBXs, Key Telephone Systems (KTS), and Centrex.

There are many published market research reports, as well as comments filed with the Commission, that project WOS, such as wireless PBX, to have a huge growth during this decade.[2] The exact number varies, but there have been market projections of wireless PBX revenues as high as $300 million by 1998.[3] For this reason, they are expected to be one of first commercial implementations of PCS. In addition, unlicensed operation is the only realistic way to offer a WOS product since these systems are usually privately owned and operated.

The most important considerations of a wireless office system are:

- Voice Quality
- Cost
- Traffic Density

There are significantly different requirements for a private WOS typically installed indoors, than for outdoor public PCS and cellular telephony. The primary difference, shown in our own research and in research of others, is in the voice quality that is demanded by the business user.[4] This user will demand a WOS to have voice quality and reliability equal to their wired telephone. Current development in digital cellular in North America, Europe, and Japan has focused on low bit rate speech compression algorithms (< 6kbps).[5] While the quality of these speech coders may be acceptable in a mobile cellular environment with car noise and other background impairments, we do not believe they provide adequate quality for an office system at

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[2] For example, see the Reply Comments of Alexander Resources to ET Docket 92-9

[3] Dataquest, May 1992

[4] Northern Business Information, "The Wireless PBX Market", August 1992
Also see Buckingham et. al., "A Business Cordless PABX Telephone System at 800 MHz Based on the DECT Technology", IEEE Communications Magazine, January 1991

[5] Telecommunications Industry Association, IS-54-B, "Dual-Mode Base Station Compatibility Standard", January 1992

this time. This high voice quality requirement, along with providing adequate capacity at a minimum of complexity and cost, is directly related to the channel bandwidth .

Wireline quality voice is typically thought of as 32 kbps ADPCM or better. It is also a telecommunications standard, which is important for a WOS that must interface to existing wireline networks. Assuming 32 kbps speech channels, the system must provide enough channels to support the expected traffic density at an acceptable grade of service.

Research has shown that traffic density within an office can be expected to be about 9200 Erlangs/km^2, with each portable generating 0.2 Erlang.[6] The number of traffic channels required to support this density depends on the cell size, frequency reuse, and customer tolerance to blocked calls. Simulations have shown that a typical TDMA/TDD system can supply that capacity with 120 traffic channels with various tradeoffs of the above parameters.[7] The amount of total bandwidth necessary depends on the system implementations. The frequency allocation for the new digital cordless system in Japan was initially set at 12 MHz for system operation testing, but a wider bandwidth is being considered for the actual development. [8]

Our research has shown that the large market projections for WOS are price sensitive. This is true for any new service, but is especially important when customers have a direct comparison: their wired telephone. They are concerned about paying a large premium above the cost of their current phone. Therefore, the design goal is to maximize the high quality speech channels while minimizing complexity. One tradeoff is to support the highest data rate possible that does not require an equalizer. The need for an equalizer depends on the channel conditions. One important measure of channel conditions is multipath delay spreads. For indoor channels, typical delay spreads are 70 ns.[9] Outdoor measurements in a congested urban area have found

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[6] Personal Handy Phone (PHP) System Report DATA No. 54-4-1, June 16, 1992 (Japan)

[7] Fapojuwo, et. al., "A Simulation Study of Speech Traffic Capacity in Digital Cordless Telephone Systems", IEEE Transactions on Vehicular Technology, February 1992

[8] Research and Development Center for Radio Systems (Japan), "Standard of the second generation cordless telephone system (RCR STD-28 Draft of First Edition), July 1992

[9] Pickering, et. al., "Measurements of the Multipath Spread of the Indoor Wireless

delay spreads averaging 250 ns.[10] Using these measurements, and assuming a reasonable error rate for voice ($< 10^{-3}$) and QPSK digital modulation, data rates of 320-400 kbps can be supported without the need of an equalizer. At these data rates, eight 32 kbps speech channels can be provided, assuming 50% of the bits are used for overhead (synchronization, error coding, etc.), or four simultaneous conversations if a TDD scheme is employed. For QPSK modulation, 250-300 kHz of signal bandwidth would be required. Other modulation schemes might require more. Therefore, a frequency spacing greater than 100 kHz is needed to support a reasonable number of voice channels at an acceptable level of complexity for a typical implementation.

These arguments show the need for more channel bandwidth than 100 kHz. We believe it would be advantageous to have an intermediate channel allocation greater than 100 kHz but less than 1.25 MHz. We are aware that some companies support CT-2 technology, which utilizes 100 kHz channel spacing, for a WOS. Our alternate proposal does not preclude such a system, but makes the rules more flexible to allow other schemes that may be more bandwidth efficient.

We assume the 100 kHz was proposed primarily for residential cordless telephones. We believe an adequate number of channels would still be available for cordless telephones under our plan. Our alternative channelization plan is listed below.

- 1910 - 1920 MHz One 10 MHz channel
- 1920 - 1930 MHz Overlay of (8) 1.25 MHz and (33) 300 kHz channels

In this plan, the 10 MHz channel for wideband systems remains and would be used primarilly by wireless LANs and wideband voice systems. The 1.25 MHz channels would be expanded from 4 to 8. The 100 kHz channels would be replaced with thirty-three 300 kHz channels overlaid on the 1.25 MHz channels. We propose that the transmit power limitations of 100 mW peak for the 1.25 MHz channels also be applied to the 300 kHz channels.

Communication Channel", Third IEEE International Symposium on Personal, Indoor, and Mobile Radio Communications, October 1992

[10] Research and Development Center for Radio Systems (RCR) Second Generation Cordless Telephone System Working Group (Japan), "Experiment report of the second generation cordless telephone system, April 1991

Our rationale for the overlay scheme is that any application should have 10 MHz as a minimum to provide adequate system capacity. The overlay plan does create more possibility for interference between different systems using the different channel plans. However, it appears to be the best alternative short of allocating more spectrum.

Other than the channelization issues discussed above, we agree with the technical standards in the Proposed Rules (Appendix A) with two exceptions. We believe that the frequency stability requirement should be less stringent and the spectrum monitoring technique should be more specific.

III. Frequency Stability

We believe the frequency stability requirement in Section 15.253 (c) of the Proposed Rules is too stringent. The design of 2 GHz oscillators to meet this tight tolerance over temperature and supply voltage variations is not consistent with the goal of minimizing equipment costs.

For the wider channels of 10 MHz and 1.25 MHz, the +/- .0001 percent tolerance is not necessary. If an alternative channelization is adopted, such as the 300 kHz channels we have proposed, it is too stringent for the narrowband channel. This tolerance should only be required for 100 kHz channels if the Commission chooses to keep them.

We do see the importance in maintaining acceptable frequency stability in a shared spectrum, and we therefore recommend a tolerance of +/- .0003 percent as a more reasonable value.

IV. Spectrum Monitoring

We strongly believe that intentional radiators should be required to monitor the spectrum before transmission. This requirement is necessary to minimize interference to incumbent fixed microwave licensees as well as other unlicensed PCS systems. The type of mechanism that is used for spectrum monitoring and the protocol for contention resolution is a difficult problem, given the myriad of technologies that are likely to be implemented. This issue is likely to be compounded by systems that employ bursty transmission, such as TDMA, where monitoring

must be done over a predetermined time window. We are not prepared to offer a solution at this time, but we are willing to support industry efforts to develop a suitable technique.

Since this issue involves interference protection, it should be included in the Rules. The current proposal in Section 15.253 (d) of the Proposed Rules (Appendix A) is not specific enough to provide adequate interference protection. It is key to early and successful deployment of unlicensed PCS.

V. Relocation and Industry Standards

We reiterate our position that to see the maximum potential benefit for unlicensed applications the band must be cleared of incumbents. The Commission has asked for comments on whether an appropriate standards committee could coordinate the relocation and negotiation of incumbents. We do not believe that is within in the charter of technical standards committees to perform this function. Their primary role should be the development of technical standards. However, we do believe that an industry group of interested parties could work together to handle these negotiations and to provide the necessary financial support.

For unlicensed PCS, we do not see the immediate need for standards, since these products will usually be independently owned. In fact, early deployment of unlicensed products implies that commercial introduction will not wait for standards. However, it may be desirable in the future for an unlicensed PCS product to have access to a public PCS network, and standards may be appropriate in this case. TIA subcommittee TR45.4 has formed a working group to study unlicensed PCS, and it may the appropriate body for such a standard.

VI. Conclusion

We agree with the Commission's decision to allocate spectrum for unlicensed PCS and recognize that these types of systems will be the first PCS products on the market. We believe that with some increased flexibility in the channelization plan and the technical standards, the Proposed Rules will hasten the introduction of many unlicensed PCS products.

We foresee the demand for unlicensed PCS products growing quickly, far in advance of licensed PCS, and hope the Commission will accept our recommendation to reserve dedicated spectrum to meet the future demand.

We also hope the Commission will seriously consider the unique requirements of wireless in-building office systems, as we have discussed in our Comments, and how these requirements impact the technical standards of the Proposed Rules.

Respectfully Submitted,

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